A Military C2 Professional's Thoughts on Visualization

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1.0   INTRODUCTION

A commander's ability to visualize his battle space is a necessary condition to winning.

I recently retired from the Canada Forces after 35 years as a command and control specialist. I have served on Communications and Information System staffs (J6) at tactical, operational and strategic level headquarters and commanded at the tactical, operational and strategic levels. I believe I understand the role of and the need for visualization in military operations well. I would like to stimulate discussion by sharing some of my experiences that are relevant to the subject.

2.0   DISCUSSION

I will relate several experiences that will demonstrate a need for better visualization and/or illustrate an aspect relevant to the 'visualization' researcher.

An Electronic Warfare (EW) Example. Today's battlefield presents a dense and hostile electronic environment. One should expect to find our Electronic Warfare sensors operating in unexpected ways, such as indicating a threat that is not present. We need to be able to quickly identify the source of ambiguity and correct it, if possible. For example, programming a 'Radar Warning Receiver' (RWR) requires that you use a set of unique parametrics for each threat radar. The RWR programmer was required to search through lengthy tabular listings of parametrics to find the conflict; a tedious and time consuming exercise. The Canadian Forces Electronic Warfare Center, through Defence Research and Development Canada, Ottawa developed a commercial of the shelf visualization product into a tool called the Visual Interface for Electronic Warfare system (VIEWS), a simple but effective tool that displays EW parametrics in three-dimensional space. It displays a threat as one or more cubes. Overlapping cubes identified ambiguities. This simple visualization tool enabled RWR programmer to easily see and optimally adjust parametrics to eliminate or at least minimize threat ambiguities. I will illustrate the VIEWS tool.

An Air Traffic Control (ATC) Example. I have found that a 'user' is never satisfied, **nor should he be**. The moment you install a system, he will learn the new functionality and begin thinking about how to improve on it. One should plan for system evolution as the user develops his understanding of the system's capabilities and limitations. Where possible one should establish a 'lead user' group to promote development of new concepts and trial them. I will provide a personal example of procuring an ATC display system. I will also comment on the need to evaluate human factors aspects such as facility layout, and display symbology and colour.

A Command and Control (C2) Example. I was NATO/ Central Army Group's Chief of Information Systems between 1990 and 1992. The Allied Central Europe Command and Control Information System was anything but 'the right information, at the right time and in the right form', today's information

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mantra. I will discuss the Commander's need (and that of his staffs') for multimedia visualization. We were able to modify the existing C2 capability with leading-edge COTS to offer the battle staff an order-of-magnitude improvement.

An Intelligence Example. As we enter the Information Age, we find we are 'drowning' in information. We need better search engines; ones based on concepts rather than words; and we need a means of visualizing the concepts. I will talk about research in these areas and the need for further research. I will briefly mention Canada's work in Cognitive Modality and a colleague, Dr. Zack Jacobson, will illustrate a work in progress called Visual Interface for Textual Analysis (VITA) in a separate presentation. Both areas need further research and development.

An Information Security Example. If you have seen an Intrusion Detection System (IDS) display, you will appreciate the need for improved visualization. The same applies to Information System logs. They produce large volumes of data that require both skill and time to analyse. In the meantime your network may be under attack. 'Ironman' is a Canadian initiative in this area. It serves as an information security command and control center that lets you visualize network activity, including IDS output, and facilitates network analysis. I will illustrate the visualization aspects of the tool.

Information Operations. IO is the warfare strategy of the Information Age. I will present an IO paradigm and show where visualization is situated within the paradigm. It will serve to focus the above examples within the concept of IO. Clearly, IST R&D is critical to advancing our ability to execute an IO strategy.

3.0   CONCLUSION

There are many facets to Visualization. The above vignettes are meant to stimulate discussion. Visualization is about enabling the mind of the decision maker, his staffs and knowledge workers in general. Information Technology Systems, indeed the 'network' are but extensions of the mind. Your task is to understand it through observation and experiment, to train it through exercise and simulation, and to provide tools to empower it to visualize. Your work is a critical and necessary enabler of the information age.

SYMPOSIA DISCUSSION – KEYNOTE ADDRESS 2

Author's Name: Col. (Ret.) Randy G. Alward, former commander, Canadian Forces Information Operations Group

Comment:
The culture of the military must be considered when introducing new technologies into NATO operations. For example, generals being able to talk over videoconference without any other filter or influence.

Comment:
Knowing what question to ask or what question can be asked is important. There are many different dimensions, and the user has to know what kind of information is available and accessible to aid in the decision making process.

Comment:
User input is essential to the development cycle. If the users are consulted in the development process, they will be more satisfied with the results. However this does not mean that they will not want more. As they learn from the new technology and system, they will know what to ask for in the next stage of development.

A Need for Visualization

by

Col(Ret'd) Randy Alward, CA

Military Background

- 35 years in military CIS
- DA for CF-104 EW systems
- DA and PM for ATC systems
- CO Comms Sqn Baden (CIS)
- Chief of Information Systems, CENTAG
- CO Comm Gp Halifax
- DEW and J6IO
- Comd CFIOG

Battlefield Visualization

the process whereby the commander develops a clear under- standing of his current state with relation to the enemy and the environment, envisions a desired end state, and then subsequently visualizes the sequence of activity that will move his force from its current state to the end state
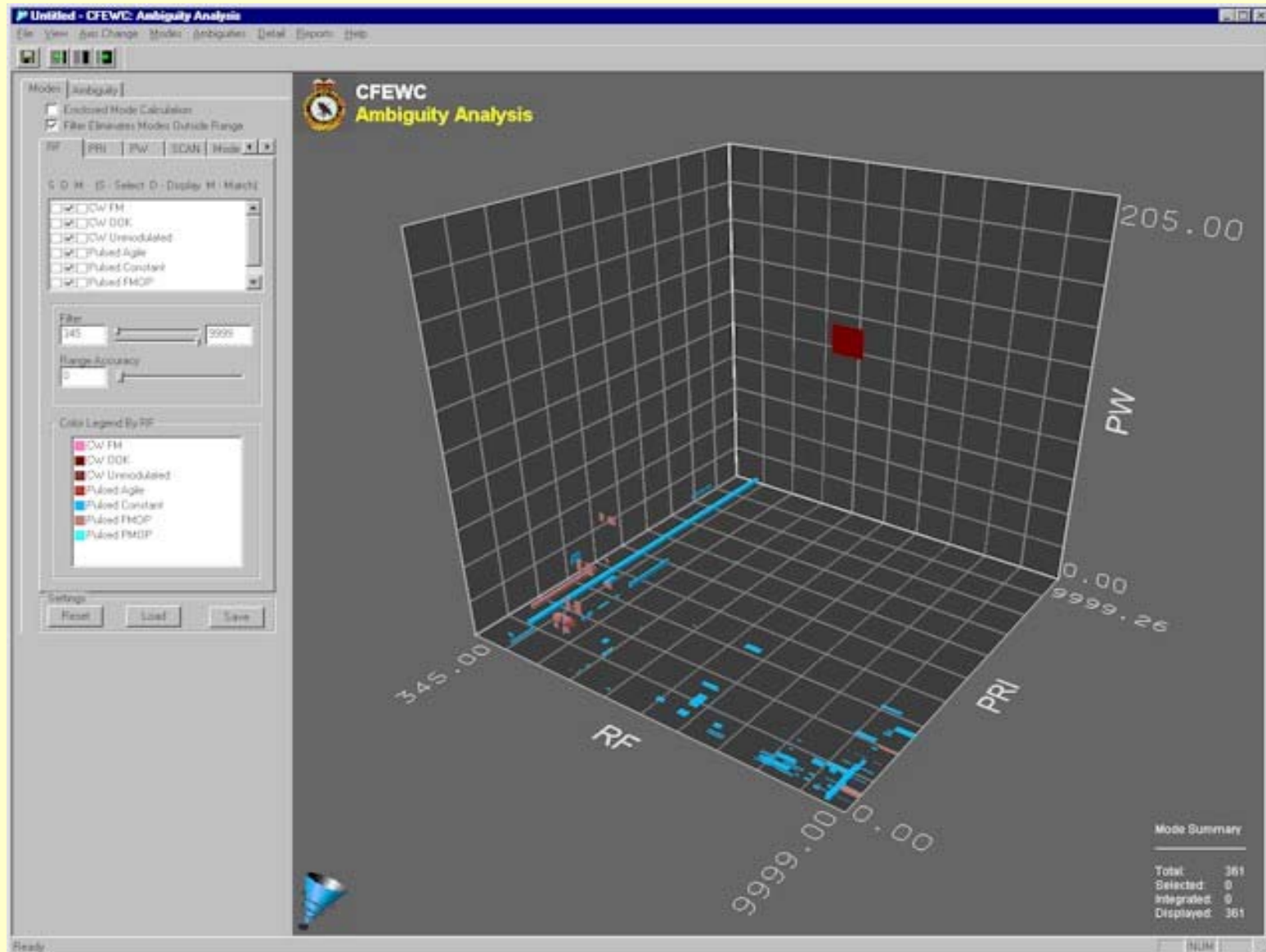
US Army

Outline

- Electronic Warfare

- Air Traffic Control

- Command and Control

- Information Security

- Signals Intelligence

- Information Operations

Electronic Warfare

- Programming Radar Warning Receiver
- Resolution of ambiguities
- VIEWS

3D Ambiguity Analysis Tool - VIEWS
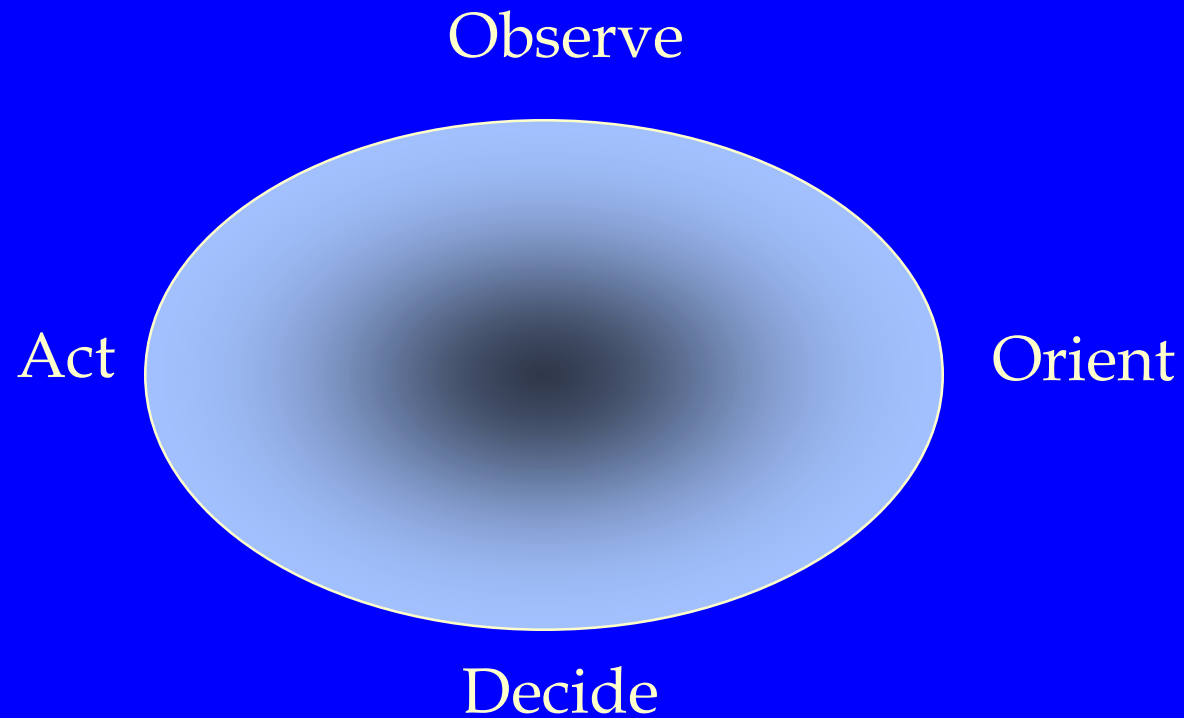
Air Traffic Control

- Design Authority (TRACS)
- Project Manager (TRADS)

Command and Control

- NATO ACCIS
  - CENTAG in 1990
- Canadian ISTAR
- Decision cycle

DECISION CYCLE

Observe

Act   Orient

Decide

OODA
Loop

Information Security

- information overload (logs and IDS)
- improved visualization

System Event Log

	Type	Date	Time	Source	Category		Event	User Computer
•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7035	SYSTEM	CR79359-A
•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7036	N/A	CR79359-A
•	Information	08-Sep-02	06:29:42	Service Control Mandager	None	7035	SYSTEM	CR79359-A
•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7036	N/A	CR79359-A
•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7035	SYSTEM	CR79359-A
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•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7035	SYSTEM	CR79359-A
•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7036	N/A	CR79359-A
•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7035	SYSTEM	CR79359-A
•	Error	08-Sep-02	06:29:42	Service Control Manager	None	7026	N/A	CR79359-A
•	Information	08-Sep-02	06:29:42	Service Control Manager	None	7035	SYSTEM	CR79359-A
•	Information	08-Sep-02	06:28:38	SNMP	None	1001	N/A	CR79359-A
•	Warning	08-Sep-02	06:28:38	SNMP	None	1102	N/A	CR79359-A
•	Warning	08-Sep-02	06:28:38	SNMP	None	1102	N/A	CR79359-A

- Plus 89 pages more

NetRanger IDS Display

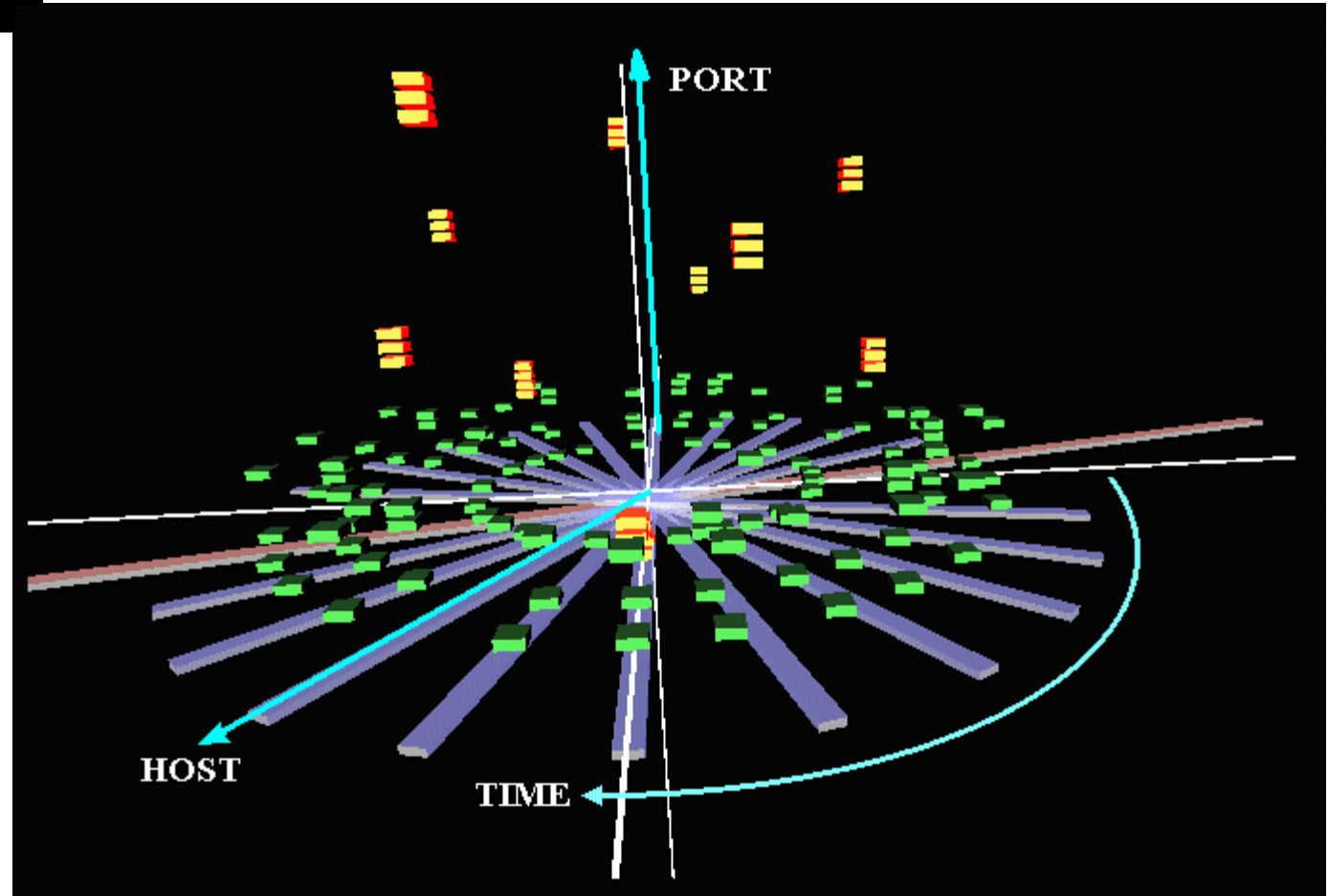SATAN – Normal   TCP Hijack, 6   Match: ++   Match: Hacker, 5
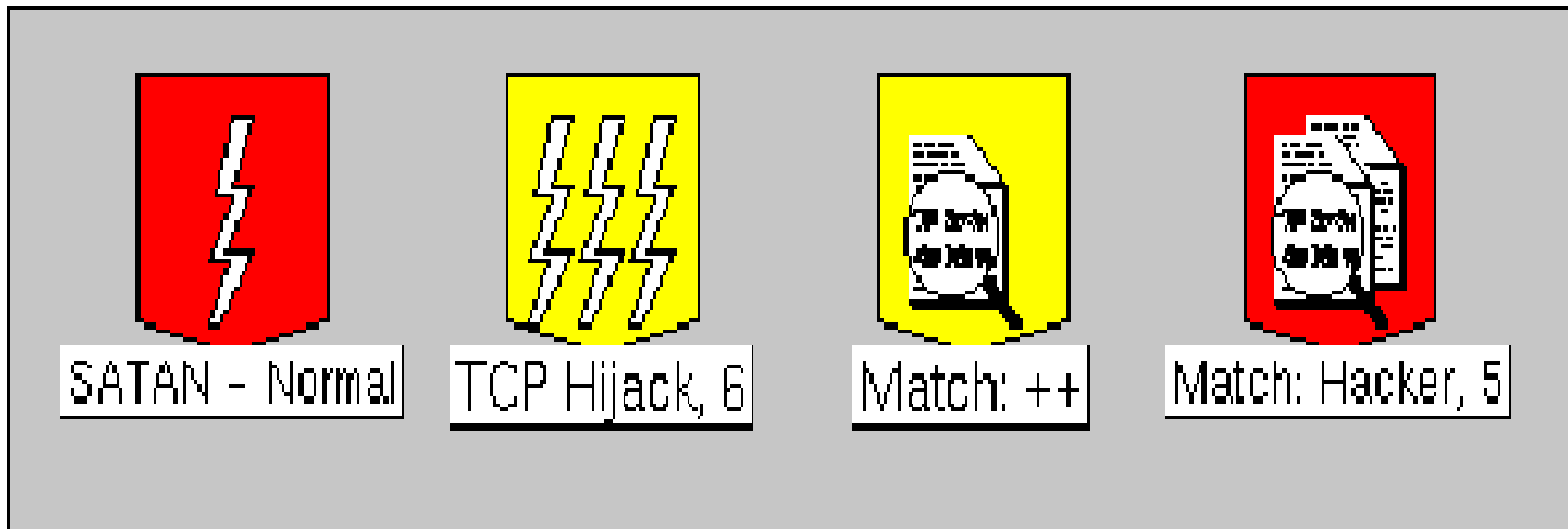
Figure 1.9:   Sample Director Alarm Icons

Information Security Application

Provides visualization of port usage and hosts in time or data segments

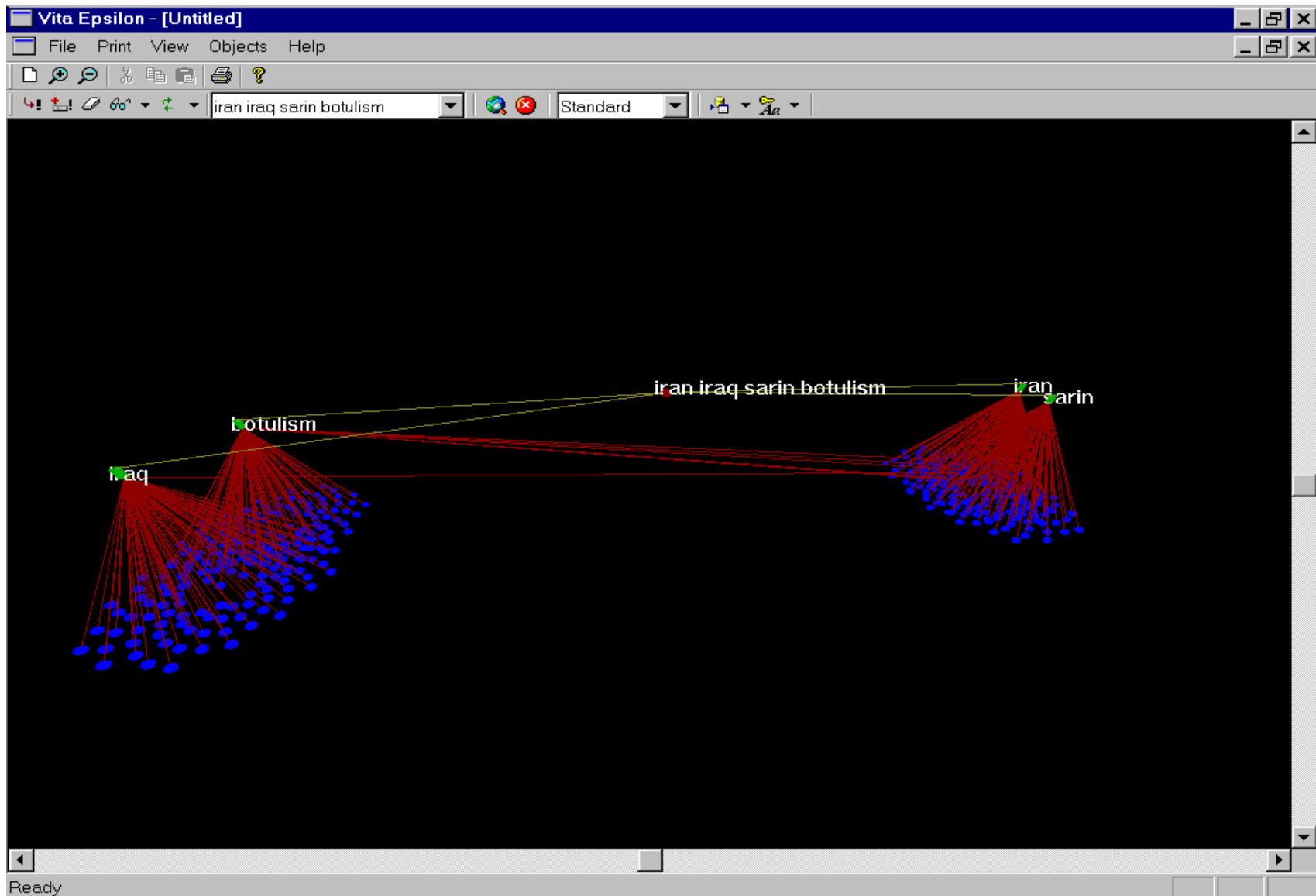Yellow boxes are hosts or ports appearing for the first time

Signals Intelligence

- Information overload (text)
- Improved visualization

Intelligence Application

Information Operations

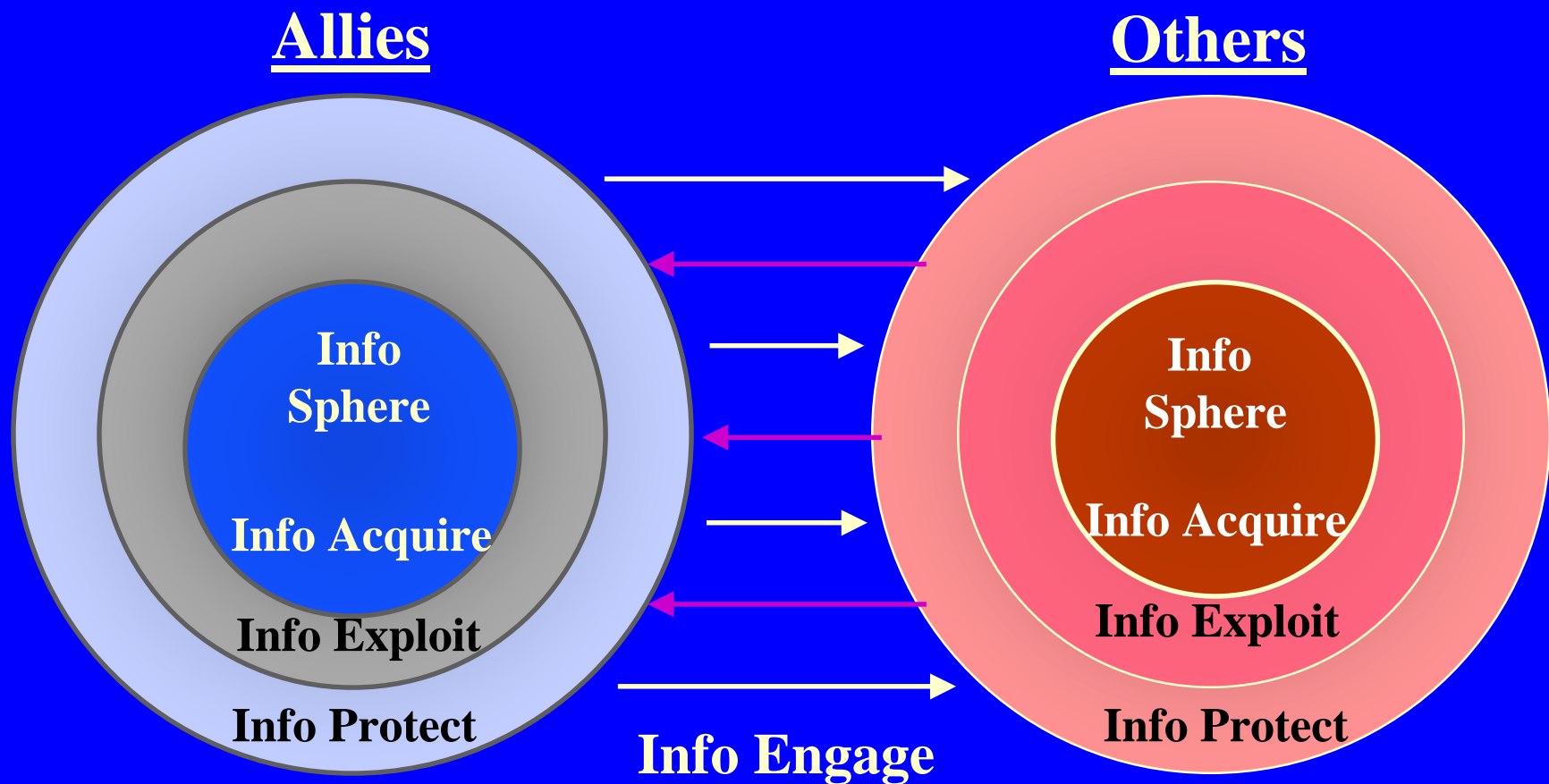- Definitions
- Paradigm
- Cyberspace

Information Operations

Actions taken in support of national objectives, which influence decision makers by affecting other's information and/or information systems while exploiting and protecting one's own information and/or information systems

An IO Paradigm

Cyber Space

Allies

Others

Info Sphere

Info Acquire

Info Exploit

Info Protect

Info Sphere

Info Acquire
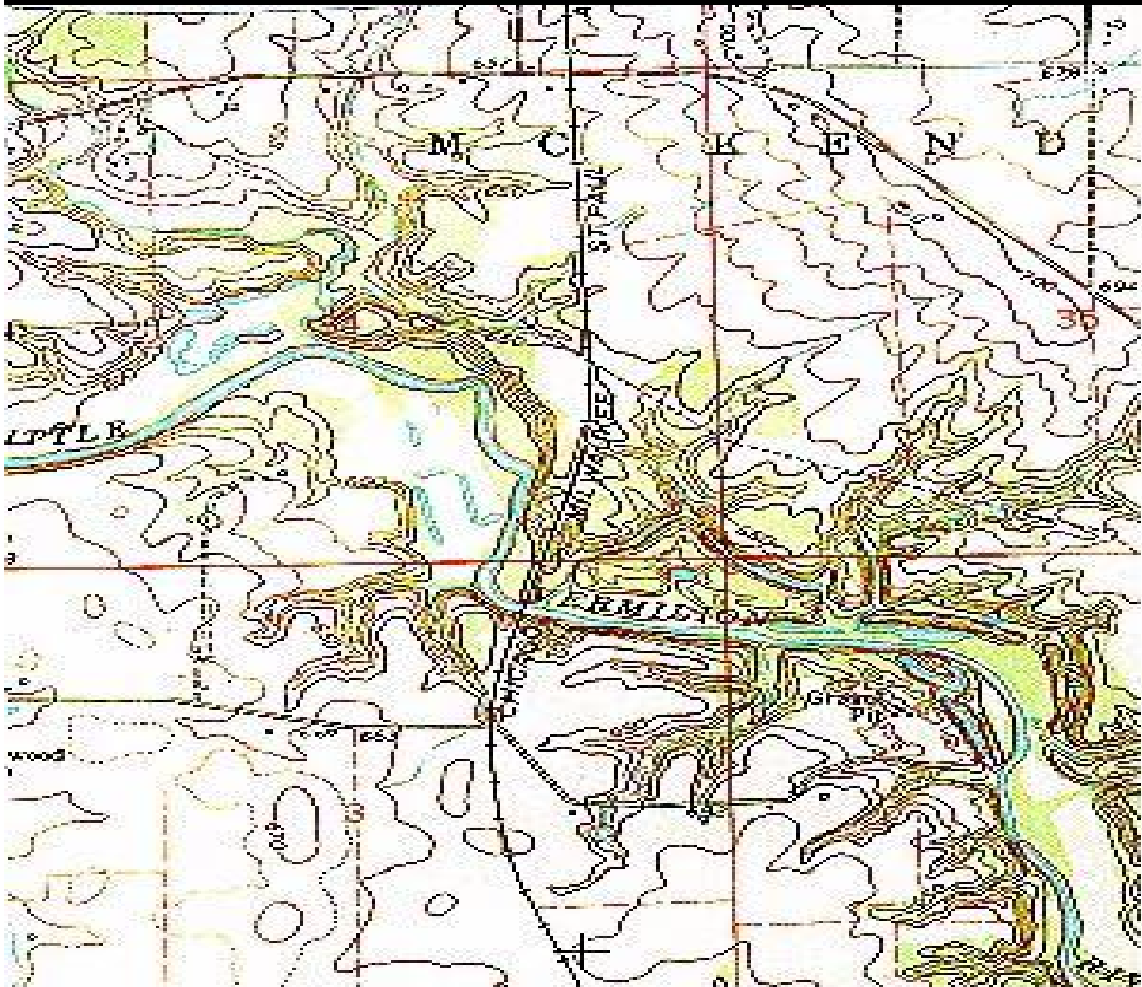
Info Exploit
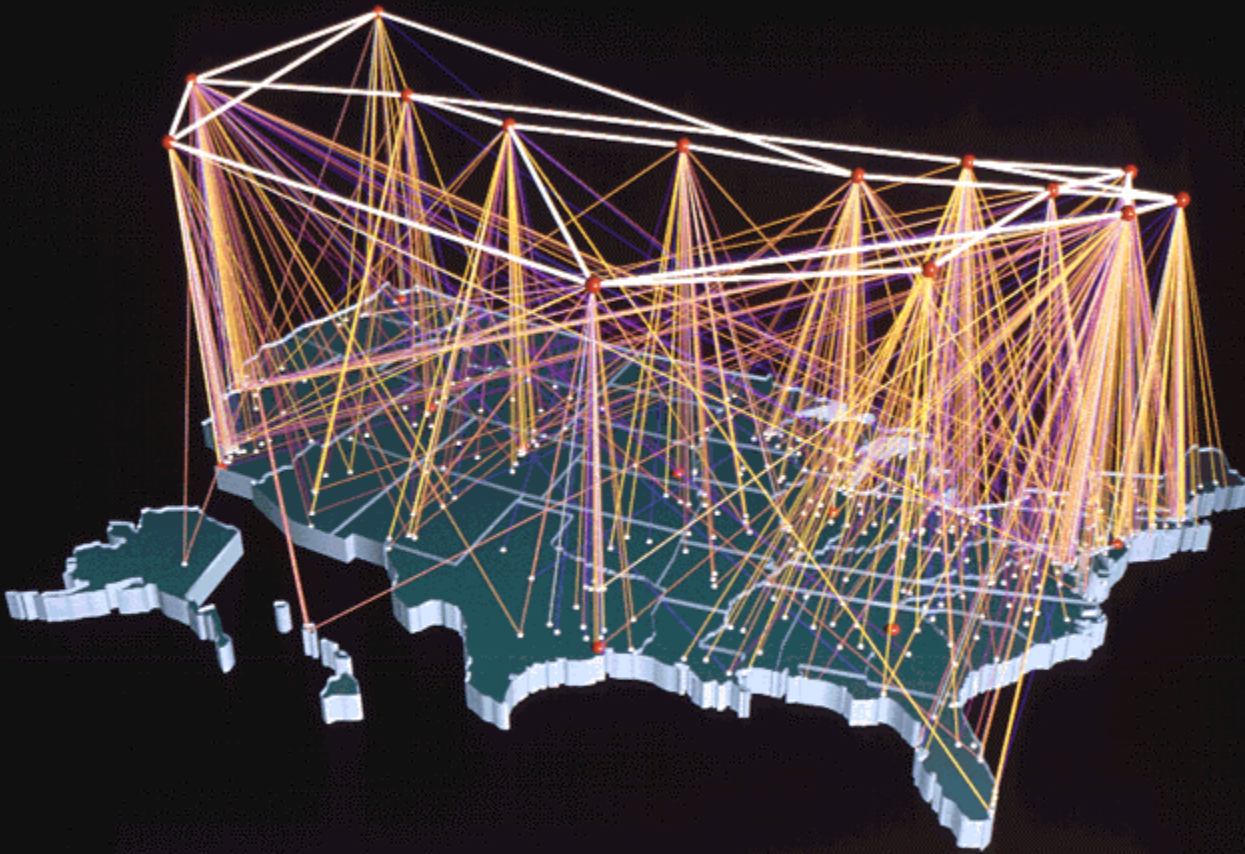
Info Protect

Info Engage

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Cyberspace

- a new battle space

- Topographical map for 3D space

- How do we map cyberspace

Topographical Map

A Mapping of Internet Traffic
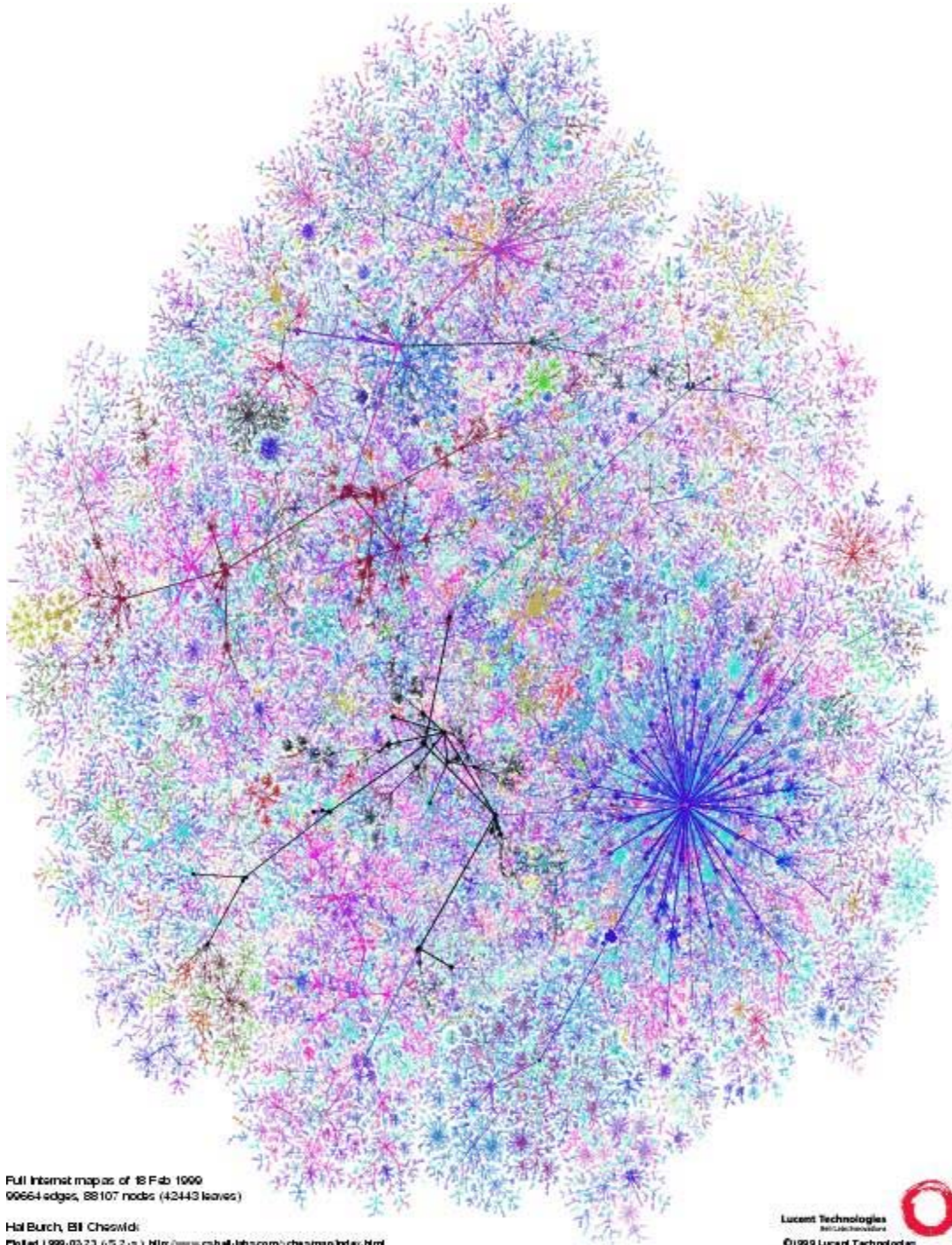
Internet Router Connectivity

Full Internet map as of 18 Feb 1999
99664 edges, 88107 nodes (42443 leaves)

Hal Burch, Bill Cheswick
Plotted 1999-03-23 (-5.2 s) http://www.cs.bell-labs.com/~ches/map/index.html

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Conclusions

- need for advancing visualization is real and present

- users are not clear on their visualization needs

- progress in visualization has been evolutionary

- engage all players in dialog

Questions/Discussion